PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-117534

(43)Date of publication of application : 27.04.2001

(51)Int.Cl. G09G 3/30
G09F 9/30
H05B 33/08
H05B 33/14

(21)Application number : 11-299082

(22)Date of filing : 21.10.1999

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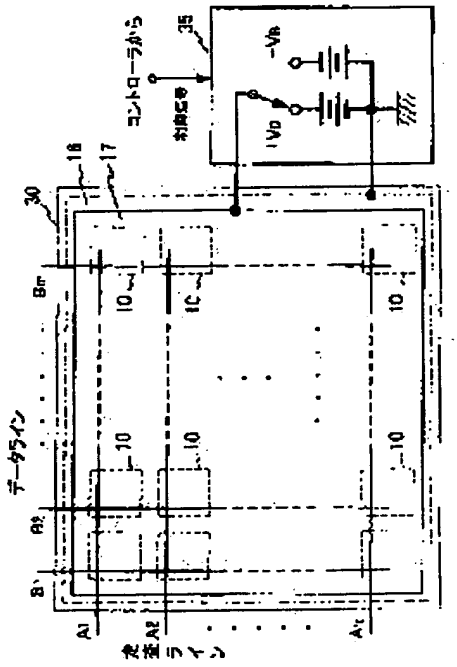
(54) ACTIVE MATRIX TYPE DISPLAY DEVICE AND DRIVING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an active matrix type display device capable of displaying a picture whose reliability is high and which is of satisfactory quality and a driving method thereof.

SOLUTION: This display device has a reverse voltage applying part for applying a reverse voltage having a polarity reverse to that of a voltage which is applied to light emitting elements at the time of light emissions of the elements. The reverse voltage is applied to them at the synchronizing timing of an input video signal or in response to the supply of a power to a power source part. Or, a reverse voltage applying period is set in a period when the video is not displayed and a driving circuit driving prescribed light emitting elements is brought into conduction in this reverse voltage applying period and also the reverse voltage is applied to the prescribed light emitting elements.



LEGAL STATUS

[Date of request for examination] 22.10.2002

[Date of sending the examiner's decision of rejection]	26.07.2004
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
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CLAIMS

[Claim(s)]
[Claim 1] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line which have been arranged in the shape of a matrix, The drive circuit which drives each of two or more of said light emitting devices, and the display and control section which controls said drive circuit according to an input video signal, The electrical potential difference which is the display of the active-matrix mold which has the power supply section which supplies power to said two or more light emitting devices, and is impressed at the time of luminescence of said light emitting device is a display characterized by having the reverse voltage impression section which impresses the reverse voltage which is an electrical potential difference of hard flow to said light emitting device.
[Claim 2] Said reverse voltage is a display according to claim 1 characterized by being impressed for every unit frame corresponding to the synchronous timing of said input video signal.
[Claim 3] It is the display according to claim 1 or 2 which said display and control section has a timer, and is characterized by impressing said reverse voltage based on the synchronous timing of said input video signal, and the output of said timer.
[Claim 4] Said reverse voltage is claim 1 characterized by being answered and impressed by powering on to said power supply section thru/or a display given in any 1 of 3.
[Claim 5] Said two or more light emitting devices are claim 1 characterized by being an organic EL device thru/or a display given in any 1 of 4.
[Claim 6] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line which have been arranged in the shape of a matrix, The drive circuit which drives each of two or more of said light emitting devices, and the display and control section which controls said drive circuit according to an input video signal, It is the drive approach of a active-matrix mold display of having the power supply section which supplies power to said two or more light emitting devices. The drive approach characterized by having the reverse voltage impression step which impresses the reverse voltage whose electrical potential difference impressed at the time of luminescence of said light emitting device is an electrical potential difference of hard flow to said light emitting device.
[Claim 7] Said reverse voltage impression step is the drive approach according to claim 6 characterized by performing for every unit frame corresponding to the synchronous timing of said input video signal.
[Claim 8] the time check which clocks the elapsed time from the synchronous timing of said input video signal -- the drive approach according to claim 6 or 7 characterized by having a step and performing said reverse voltage impression step based on said elapsed time.
[Claim 9] Said reverse voltage impression step is claim 6 characterized by powering on to said power supply section answering and performing thru/or the drive approach given in any 1 of 8.
[Claim 10] Claim 6 characterized by using an organic EL device as said two or more light emitting devices thru/or the drive approach given in any 1 of 9.
[Claim 11] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line which have been arranged in the shape of a matrix, The drive circuit which drives each of two or more of said light emitting devices, and the display and control section which controls said drive circuit according to an input video signal, In the setting section which sets up the reverse

voltage impression period which is the display of the active-matrix mold which has the power supply section which supplies power to said two or more light emitting devices, and impresses reverse voltage, and said reverse voltage impression period The display characterized by having the reverse voltage impression section which impresses the reverse voltage whose electrical potential difference impressed to said predetermined light emitting device at the time of luminescence while making it flow through the drive circuit which drives the predetermined light emitting device of said two or more light emitting devices is an electrical potential difference of hard flow.

[Claim 12] Said reverse voltage impression period is a display according to claim 11 characterized by being set as the period which does not perform the display about said input video signal.

[Claim 13] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line which have been arranged in the shape of a matrix, The drive circuit which drives each of two or more of said light emitting devices, and the display and control section which controls said drive circuit according to an input video signal, The step which sets up the reverse voltage impression period which is the drive approach of a active-matrix mold display of having the power supply section which supplies power, and impresses reverse voltage to said two or more light emitting devices, The step which makes it flow through the drive circuit which drives the predetermined light emitting device of said two or more light emitting devices, and the electrical potential difference impressed to said predetermined light emitting device at the time of luminescence are the drive approach characterized by having the step which impresses the reverse voltage which is an electrical potential difference of hard flow.

[Claim 14] Said reverse voltage impression period is the drive approach according to claim 13 characterized by being set as the period which does not perform the display about said input video signal.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a active-matrix mold indicating equipment, the indicating equipment which used the active-matrix mold display panel which has light emitting devices, such as an organic electroluminescence element, especially, and its drive approach.
[0002]
[Description of the Prior Art] Development of the matrix mold display using the luminescence display panel constituted by arranging a light emitting device in the shape of a matrix is furthered widely. As a light emitting device used for such a display panel, there is an electroluminescence (EL) component which used the organic material as a luminous layer, for example. In this organic EL device, the luminescence brightness is controllable by the current which flows a component. As a display panel using an organic EL device, there are a passive-matrix mold display panel which has only arranged the organic EL device in the shape of a matrix, and a active-matrix mold display panel which added the driver element which becomes each of the organic EL device which has arranged in the shape of a matrix from a transistor. Compared with a passive-matrix mold display panel, a active-matrix mold display panel is a low power, and has an advantage, like there are few cross talks between pixels, and fits the big screen display and the high definition display especially.
[0003] An organic EL device (an EL element is only called hereafter) can be expressed with the electrostatic capacity C connected to juxtaposition at the luminescence element E which has diode characteristics, and this as the equal circuit is shown in drawing 1 . That is, only when a current flows in the luminescence element E in the forward direction, an EL element emits light. Moreover, as shown in drawing 2 , on the transparence substrate 1, the laminating of an anode plate (transparent electrode) 2, the luminous layer 3 containing an organic material, and the cathode (metal electrode) 4 is carried out one by one, and an EL element is formed. If the drive current source 5 is connected to an anode plate 2 in the forward direction of an EL element and cathode 4 is connected to a ground, a drive current will flow to a luminous layer 3, and an EL element will emit light.
[0004]
[Problem(s) to be Solved by the Invention] However, in the luminescence display of the conventional active-matrix mold mentioned above, when the part where thickness is thin was in the formed luminous layer, or when a luminous layer did not exist partially but an anode plate and cathode contacted, leakage current occurred between cathode and an anode plate, and there was a problem of causing poor luminescence. That is, since electric resistance is small and a drive current concentrates the thin part of a luminous layer on the part [else], the drive current which flows to other normal luminous layers decreases, and luminescence brightness falls. The current concentration produced in the poor formation section of such a luminous layer does effect also to other light emitting devices, and the image displayed on a display will become unsightly.
[0005] The purpose of this invention solves the above-mentioned problem, and is to offer the display of the active-matrix mold in which image display with it is possible. [high reliability and] [good]
[0006]
[Means for Solving the Problem] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line with which the indicating equipment by this invention has been arranged in the shape of a matrix, The drive circuit which drives each of two or more light

emitting devices, and the display and control section which controls a drive circuit according to an input video signal, It is the display of the active-matrix mold which has the power supply section which supplies power to two or more light emitting devices, and is characterized by having the reverse voltage impression section which impresses the reverse voltage whose electrical potential difference impressed at the time of luminescence of a light emitting device is an electrical potential difference of hard flow to a light emitting device.

[0007] As a description of this invention, the above-mentioned reverse voltage is impressed for every unit frame corresponding to the synchronous timing of an input video signal. As other descriptions of this invention, the above-mentioned display and control section has a timer, and reverse voltage is impressed based on the synchronous timing of an input video signal, and the output of a timer. Furthermore, the above-mentioned reverse voltage is answered and impressed to powering on to a power supply section as other descriptions of this invention.

[0008] Two or more light emitting devices allotted to the crossover location of the scanning line and the data line with which the indicating equipment by this invention has been arranged in the shape of a matrix, The drive circuit which drives each of two or more light emitting devices, and the display and control section which controls a drive circuit according to an input video signal, In the setting section which sets up the reverse voltage impression period which is the display of the active-matrix mold which has the power supply section which supplies power to two or more light emitting devices, and impresses reverse voltage, and a reverse voltage impression period While making it flow through the drive circuit which drives the predetermined light emitting device of two or more above-mentioned light emitting devices, it is characterized by having the reverse voltage impression section which impresses the reverse voltage whose electrical potential difference impressed to the predetermined light emitting device concerned at the time of luminescence is an electrical potential difference of hard flow.

[0009] As other descriptions of this invention, a reverse voltage impression period is set as the period which does not perform the display about an input video signal.

[0010]

[Embodiment of the Invention] The example of this invention is explained to a detail, referring to a drawing. In addition, in drawing used in the following explanation, the same reference mark is substantially given to the equivalent part. Although the leakage current by the short circuit was generated in the part where the thickness of a luminous layer is thin as mentioned above, the artificer of this application found out changing into the condition of not connecting this part with the time of luminescence too hastily by impressing the electrical potential difference of hard flow at a light emitting device. This invention is made based on this phenomenon. First, it explains, referring to drawing about this phenomenon.

[0011] As shown in drawing 3 thru/or drawing 5 , on the transparence substrate 1, the laminating of an anode plate (transparent electrode) 2, the luminous layer 3 containing an organic material, and the cathode (metal electrode) 4 is carried out one by one, and a light emitting device is constituted. Moreover, reference mark 3A shows the poor film thickness section of the thickness of a luminous layer 3. Since the light emitting device has diode characteristics as mentioned above, even if it impresses the electrical potential difference of hard flow with the time of luminescence to a normal light emitting device, a current does not flow. However, if thickness poor section 3A of low resistance exists, since it will concentrate on thickness poor section 3A and a current will flow, to thickness poor section 3A, leakage current more excessive than the time of luminescence flows.

[0012] Consequently, as shown in drawing 4 , thickness poor section 3A and the luminous layer 3 of the circumference of it are evaporated, and by the expansion pressure, cathode 4 exfoliates from an anode plate 2, and they swell up. If expansion furthermore progresses, cathode 4 is destroyed, and as shown in drawing 5 , the residual section of cathode 4 is crooked in the direction which separates from an anode plate 2. In the case of the condition of drawing 4 or drawing 5 , luminescence does not carry out the part as for which cathode 4 carried out a curve or fracture crookedness. However, since cathode 4 and an anode plate 2 are separated, leakage current is not generated, either. Therefore, other parts of the light emitting device except this fracture section and light emitting devices other than this emit light normally, and can avoid poor luminescence resulting from leakage current.

[0013] Thickness poor section 3A of a luminous layer is formed with dust, dust, etc. which adhered on the anode plate 2 at the time of manufacture. In addition to the thickness of the poor thickness section, the leakage current which produces poor luminescence is generated in connection with the drive passage of time according to the operating environment of a display panel etc. Drawing 6 shows one example of the circuitry corresponding to one pixel 10 of a active-matrix mold display panel.

[0014] In drawing 6 , the gate G of FET (Field Effect Transistor)11 (transistor for address selections) is connected to the address scan electrode line (scan line) by which an address signal is supplied, and the source S of FET11 is connected to the data electrode line (data line) by which a data signal is supplied. It connects with the gate G of FET12 (transistor for a drive), and the drain D of FET11 is connected to one terminal of a capacitor 13. The source S of FET12 is connected to the cathode 16 common to a display panel with the other-end child of a capacitor 13, and the common cathode 16 is grounded. The drain D of FET12 is connected to the cathode of EL element 15, and the anode plate of EL element 15 is connected to the anode plate 17 common to EL element 15 in a display panel.

[0015] If the luminescence control action of this circuit is described, if ON state voltage is supplied to the gate G of FET11 in drawing 6 , FET11 will pass first the current corresponding to the electrical potential difference of the data supplied to Source S from Source S to Drain D. FET11 becomes that the gate G of FET11 is OFF state voltage with the so-called cut-off, and the drain D of FET11 will be in an opening condition. Therefore, a capacitor 13 is charged, the electrical potential difference is supplied to the gate G of FET12, the current based on the gate voltage and source electrical potential difference flows through EL element 15 to FET12, and the gate G of FET11 makes EL element 15 emit light at the period of ON state voltage. Moreover, if the gate G of FET11 becomes OFF state voltage, FET11 will be in an opening condition, the electrical potential difference of Gate G will be held with the charge accumulated in the capacitor 13, FET12 will maintain a drive current till the next scan, and luminescence of EL element 15 will also be maintained. In addition, since a gate input capacitance exists between the gate G of FET12, and Source S, even if it does not form a capacitor 13, the same actuation as the above is possible.

[0016] The circuit corresponding to 1 pixel of the display panel which performs luminescence control by active-matrix drive is constituted in this way, and when EL element 15 of the pixel concerned drives, luminescence of the pixel concerned is maintained. As described above, in a active-matrix mold display panel, luminescence control of each light emitting device is made by controlling the drive circuit containing driver elements, such as FET.

[0017] Drawing 7 shows roughly the configuration of the organic electroluminescence display 20 using the active-matrix mold display panel which is the 1st example of this invention. In drawing 7 , the analog-to-digital (A/D) transducer 21 is changed into digital video-signal data in response to an analog video-signal input. The digital video signal acquired by conversion is supplied to a frame memory 24 from A/D converter 21, and the digital video-signal data of an one-frame unit are once memorized by the frame memory 24.

[0018] On the other hand, by controlling the digital video-signal data memorized by the above-mentioned frame memory 24 using the train address counter 22 and the line address counter 23 by two or more subfields which make a parameter the luminescence period which is different from each other, the display and control section 26 which controls each part in the organic electroluminescence display 20 is changed into the gradation indicative data of plurality (namely, the number of subfields), and is supplied to a multiplexer 25 one by one with luminescence and nonluminescent data corresponding to the address of the pixel of the luminescence display panel 30, respectively.

[0019] Moreover, a display and control section 26 is controlled to make the string data corresponding to each subfield hold to the data latch circuit (not shown) which the data driver 28 has in order of the array of a pixel one by one from the 1st line (the 1st scan line) out of luminescence and nonluminescent data supplied to the multiplexer 25. A display and control section 26 makes EL element 15 contained by the scan driver 27 in a corresponding scan line emit light to coincidence while supplying the string data for every subfield in which sequential maintenance was carried out by the data latch circuit to a display panel 30 for every scan line. moreover, the display and control section 26 -- a time check -- it has equipment (timer) inside and the reverse voltage impression circuit / power supply section 35 connected to the common cathode 16 and the common anode plate

17 of a display panel 30 are controlled.
[0020] As shown in drawing 8 , a reverse voltage impression circuit / power supply section 35 has a switching circuit and the power source which supplies driver voltage (+VD) and reverse voltage (-VB) to EL element 15, and makes the control about the reverse voltage impression to each EL element 15 mentioned [which mentions later and driver-voltage-impresses] later under control of a display and control section 26. In addition, as shown in drawing 9 , in this example, control of brightness gradation is made by the approach based on a subfield 2 n-th-order tone method (n= 8). Namely, the one-frame period in an input video signal is divided into eight subfields (SF1-SF8). phase contrast of the brightness within each subfield period (namely, the luminescence period of each EL element 15 within each subfield period: T1-T8) -- respectively -- order -- 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, and 1/256 (that is) It is set up so that it may be set to 1 / 21 - 1/28, and it is controlled by the alternative combination of those subfields possible [256 kinds of brightness gradation displays].
[0021] Luminescence control of each EL element 15 is performed for every subfield. That is, it is carried out about each string data from the 1st subfield to the 8th subfield by the data unit of one frame. To each of each subfield supplied, luminescence control only of the predetermined luminescence period is carried out, and each EL element 15 of a display panel 30 can perform the luminescence display for one frame by multi-tone display. In addition, the image display device using this subfield 2 n-th-order tone method is indicated by JP,10-312173,A by the same applicant as this application.
[0022] It explains to a detail, referring to the timing diagram shown below at drawing 10 about the display control and reverse voltage impression control action which are performed by the display and control section 26. A display and control section 26 carries out sequential sending out of the scan signal (write-in signal) corresponding to the 1st subfield (SF1) from the 1st scan line in the n-th scan line, and performs line sequential scanning while it controls an electrical-potential-difference impression circuit / power supply section 35 and impresses driver voltage (+VD) to the common anode plate 17. In this 1st subfield period, EL element 15 of each scan line emits light according to the video-signal data sent out from the data latch circuit in the data driver 28. That is, EL element 15 of the address to which the data in which luminescence is shown are supplied emits light.
[0023] When a display and control section 26 carries out predetermined time progress from the time (at namely, the termination time of an address period) of finishing sending out a scan signal to all scan lines, it controls the switch of an electrical-potential-difference impression circuit / power supply section 35, and impresses reverse voltage (-VB) to the common anode plate 17. After a predetermined reverse voltage impression period (Tb) passes, a switch is changed from reverse voltage to driver voltage, and EL element 15 is made to emit light again. In addition, it is prepared so that it may end, before the 2nd subfield of the 1st scan line starts a reverse voltage impression period (Tb) in this case (i.e., before the following scan signal is sent out to the 1st scan line).
[0024] After the 1st subfield period of the 1st scan line expires, a display and control section 26 carries out sequential sending out of the scan signal corresponding to the 2nd subfield (SF2) from the 1st scan line the same with having described above in the n-th scan line, and performs line sequential scanning. In addition, in this example, since reverse voltage impression is performed only to the 1st subfield, reverse voltage impression is not made in the 2nd - the n-th subfield (SF2-SFn). That is, to an one-frame period, it is controlled so that reverse voltage impression is performed only in one subfield period.
[0025] As described above, by impressing reverse voltage to the luminous layer of a display panel, a defect part is removed and can realize the display of the active-matrix mold in which image display with it is possible. [high reliability and] [good] In the above-mentioned example, although the case where reverse voltage impression was performed in the 1st subfield period was explained to the example, reverse voltage impression may be performed in the subfield period of not only the 1st subfield period but arbitration. Moreover, you may go not only to one subfield but to two or more subfields. Furthermore, it is not necessary to necessarily impress reverse voltage for every frame for example, and every several frames may be made to perform reverse voltage impression suitably.
[0026] Drawing 11 is a timing diagram which shows typically the reverse voltage impression control in the active-matrix mold display panel 30 which is the 2nd example of this invention. The case

where how subfield gradation methods differ is used differs from the example which this example described above as the control approach of brightness gradation. For example, there is a method of performing gradation control by changing the input signal level of Drive FET as one example of such an approach. Also to the case where the subfield method is not used, this invention can be applied, and as shown in drawing 11 , a reverse voltage impression period can be prepared in arbitration within the frame period except an address period. Therefore, not only the timing of reverse voltage impression but the die length and the frequency to impress of an impression period can be suitably adjusted by controlling a reverse voltage impression circuit.

[0027] Next, the 3rd example of this invention is explained below, referring to drawing 12 . Drawing 12 shows the reset period established in order to impress reverse voltage to EL element 15. This reset period is established apart from the display period of image data at the period which does not perform graphic display. In this example, a display and control section 26 sets up a reverse voltage impression period in a drive circuit "on" period and a drive circuit "on" period within a reset period. A drive circuit "on" period is a period which makes it flow through the drive circuit containing driver elements, such as FET which drives each EL element. Moreover, a reverse voltage impression period is a period when the common anode plate 17 is connected to reverse voltage (-VB) like the above-mentioned example. Therefore, in the period on which a drive circuit "on" period and a reverse voltage impression period fall, reverse voltage is impressed to an EL element from a power supply section 35.

[0028] In this example, by connecting the common anode plate 17 to reverse voltage, a display and control section 26 can impress reverse voltage to the predetermined EL element concerned, and, thereby, can remove a defect part while it makes it flow through the drive FET 12 which drives a predetermined EL element. A reset period can be established at the period of the arbitration which does not have effect in image display, such as the time of the change of the power up to equipment, and an input image channel. Moreover, the predetermined EL elements to which reverse voltage is impressed in 1 time of a reset period may be all EL elements for example, in the EL element on a predetermined scan line or a data line, or a display panel 30. According to this example, reverse voltage can be impressed to a desired EL element to desired timing.

[0029] In addition, in the above-mentioned example, although the EL element by which only the luminous layer was formed between cathode and an anode plate was explained to the example, even if it is the case where stratum functionale other than a luminous layer, such as an electronic transportation layer and a hole transportation layer, is formed, this invention is applicable. Moreover, in the above-mentioned example, although the case where an organic EL device was used was explained to the example, not only this but when other display devices, for example, display devices, such as an inorganic EL element, are used, it can apply.

[0030] Furthermore, the above-mentioned example is instantiation, suitably, can be combined variously and can be applied.

[0031]

[Effect of the Invention] According to this invention, the display of the active-matrix mold in which image display with it is possible is realizable so that clearly from having described above. [high reliability and] [good]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the equal circuit of an EL element.
[Drawing 2] It is the sectional view showing the layer structure of an EL element typically.
[Drawing 3] It is the sectional view showing typically the layer structure of the EL element section which has the poor thickness section.
[Drawing 4] It is the sectional view showing typically the configuration after impressing reverse voltage to the EL element section shown in drawing 3 .
[Drawing 5] It is the sectional view showing typically the configuration after impressing reverse voltage to the EL element section shown in drawing 3 .
[Drawing 6] It is drawing showing one example of the circuitry corresponding to one pixel of a active-matrix mold display panel.
[Drawing 7] It is drawing showing roughly the configuration of the organic electroluminescence display using the active-matrix mold display panel which is the 1st example of this invention.
[Drawing 8] It is drawing showing typically the electrical-potential-difference impression circuit / power supply section connected to a display panel and common cathode, and a common anode plate.

[Drawing 9] It is drawing showing the relation between the frame period in the subfield method, a subfield period, and an address period.
[Drawing 10] In the 1st example of this invention, it is the timing diagram which shows the display control and reverse voltage impression control action which are performed by the display and control section.
[Drawing 11] It is the timing diagram which shows typically the reverse voltage impression control in the active-matrix mold display panel which is the 2nd example of this invention.
[Drawing 12] It is drawing showing a reset period including the drive circuit "on" period and reverse voltage impression period which are established in addition to a graphic display period.
[Description of Notations in the Main Part]
1 Transparence Substrate
2 Anode Plate (Transparent Electrode)
3 Luminous Layer
3A Poor thickness section
4 Cathode (Metal Electrode)
10 Pixel
11 FET for Address Selections
12 FET for Drive
13 Capacitor
15 Light Emitting Device
16 Common Cathode
17 Common Anode Plate
20 Display
21 A/D Converter
22 Train Address Counter
23 Line Address Counter

24 Frame Memory
25 Multiplexer
26 Display and Control Section
27 Scan Driver
28 Data Driver
30 Display Panel
35 Reverse Voltage Impression Circuit / Power Supply Section

[Translation done.]

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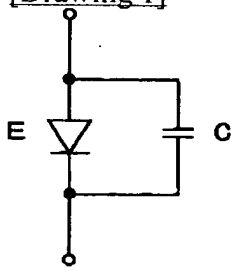
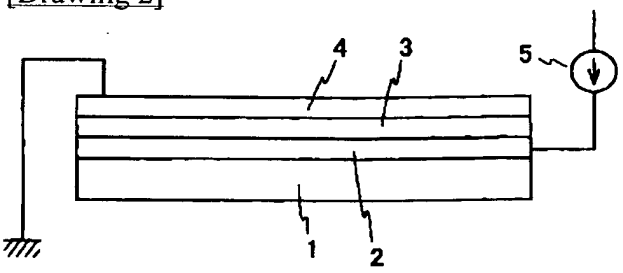
DRAWINGS

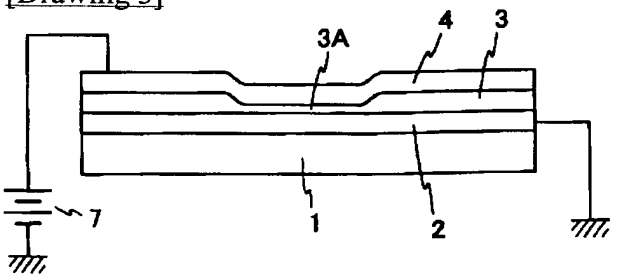
[Drawing 1]



[Drawing 2]



[Drawing 3]



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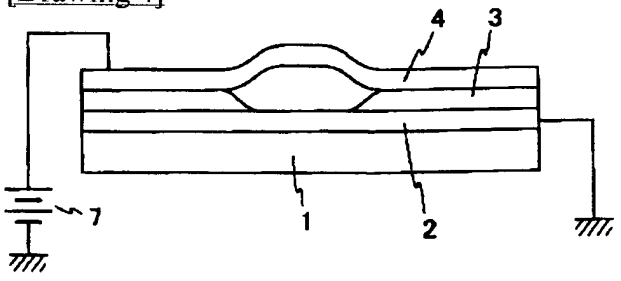
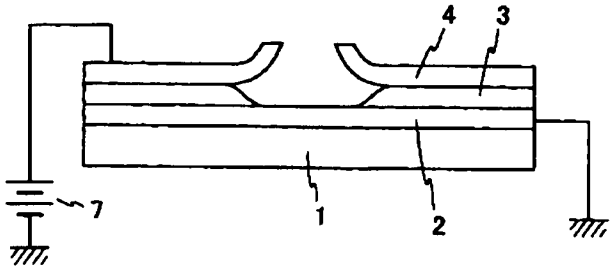
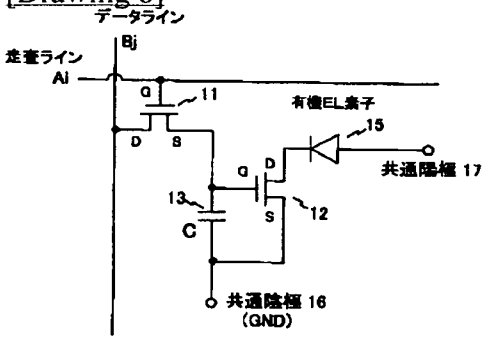


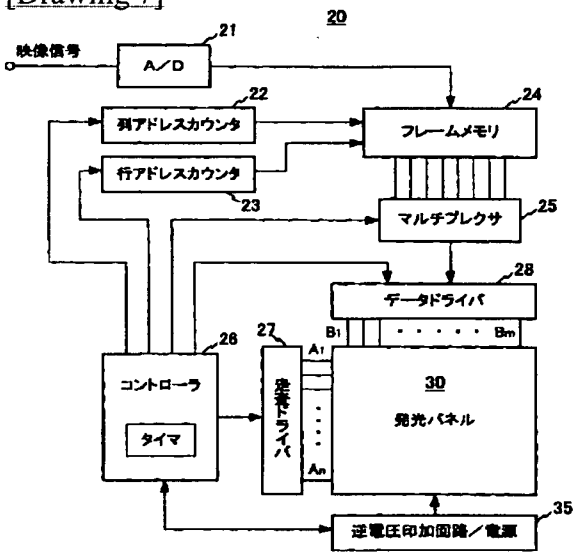
[Drawing 5]



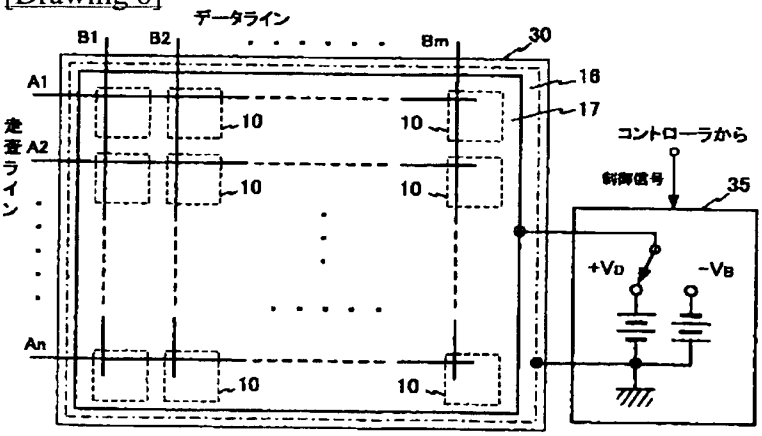
[Drawing 6]



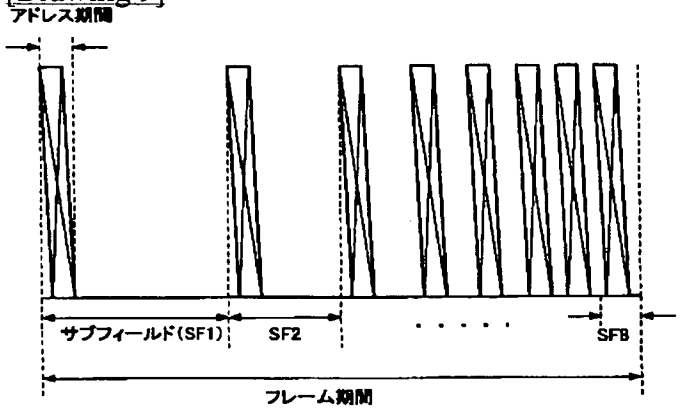
[Drawing 7]



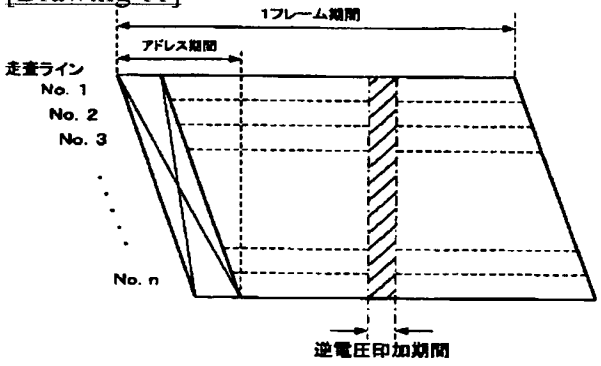
[Drawing 8]



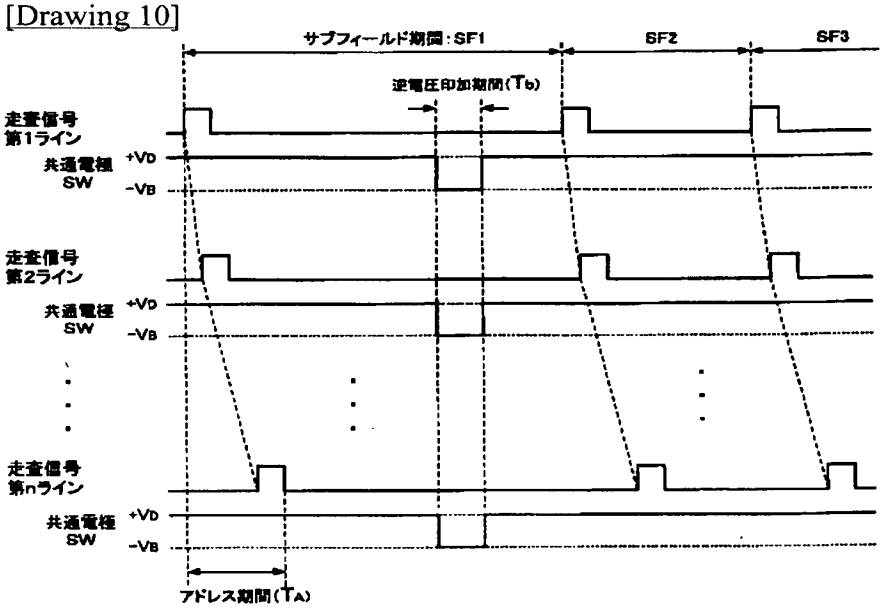
[Drawing 9]



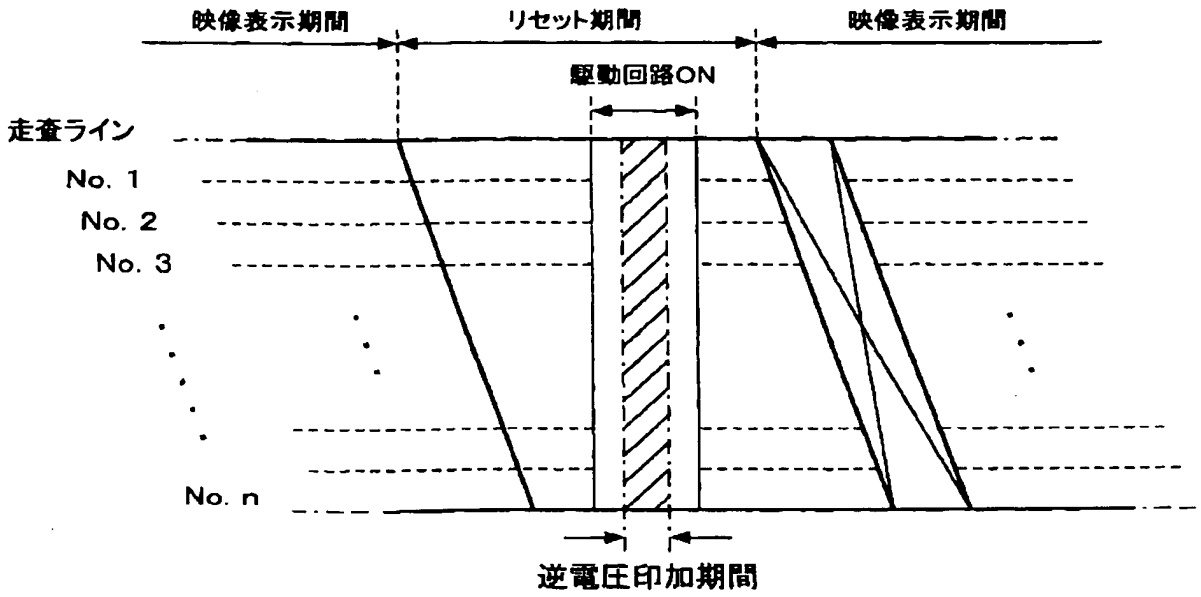
[Drawing 11]



[Drawing 10]



[Drawing 12]



[Translation done.]